AML OCEANOGRAPHIC
Xchange your old ideas

Smart·X
User Manual

Version 1.31 06 December 2012

Revision	Date of Revision	Changes	Name
Version 1.3	05 November 2012	Added Revisions Table. Updated website information. Added output units table for sensors. Updated table of contents and Ordering Codes.	Erika Ladouceur
Version 1.31	06 December 2012	Updated secondary blanking plug image.	Erika Ladouceur

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General Description of the Instrument

The AML Oceanographic X series instruments and sensors provide a major advancement in ocean instrumentation. The swappable and interchangeable sensor technologies dramatically improve the capabilities of ocean instrumentation. These capabilities include:

- Changing the instrument sensor types, while at sea, within seconds, and without tools. For example the same instrument can be changed from a CTD to a sound speed profiler.
- The sensor ranges can be swapped as sampling conditions change to maximize the instrument's resolution and accuracy. For example, a deep pressure sensor can be swapped for a shallow pressure sensor, and the salt water conductivity sensor can be swapped for a fresh water conductivity sensor.
- Sensors from one instrument can be swapped to another instrument to maintain mission critical capabilities.
- Calibrated sensors can be sent to the instrument so that the instrument does not need to be removed from service for calibration.
- Spare sensors ensure that an instrument can be immediately returned to service after catastrophic damage, such as a high speed impact with the ship's hull.
- All calibration and traceability data resides within each sensor. There is no need update instrument configuration files or coefficients. Calibration data for all sensors is instantly available from the instrument, and calibration certificates can be printed from AML Oceanographic's SeaCast software whenever the instrument is connected.
- Logged data is stamped with sensor traceability and instrument configuration data. So there is never a doubt about how the data was collected or the status of the sensor's calibration.
- Since only the sensors need to be returned for recalibration the shipping costs are dramatically reduced.

The Smart•X is the compact, multi-sensor, externally powered, data via cable, instrument of the X series family. It is designed primarily for AUV/ROV, and sea chest operations. Communications with the Smart•X are accomplished with RS-232 or RS-485.

There are two configurations of the Smart•X. One is a mult-parameter and the other is single sensor. These are listed below with a brief description.

P1S2: Multi-parameter – this configuration is equipped with one primary Xchange™ sensor port (I.e. conductivity or sound speed) and two secondary Xchange™ sensor ports (I.e. temperature and pressure). Sampling rates are programmable by time (25 Hz to every 24 hours). This unit carries with it the complete benefits of a X-series instrument.

P1S0: Single primary sensor. This configuration closely duplicates the original Smart SV as it is of similar form fit and function. It is often utilized when a replacement of a Smart SV is required for both size and data format requirements. For this style of instrument, please disregard reference to Conductivity, Temperature and Pressure in this manual.

Which Manual Do I Start With?

AML Oceanographic' Xchange™ instruments are shipped with several manuals on the CD:

- An instrument manual (ie. This Smart•X manual) which provides an overview on how to use and maintain the instrument;
- A software manual (ie. SeaCast) which provides instructions on how to use the software to configure the instrument and review instrument data;
- Xchange™ sensor manuals (C•Xchange™, SV•Xchange™, P•Xchange™, and T•Xchange™) which provide overviews on how to install and maintain each of the Xchange™ sensors;

If you are configuring an instrument for field use or lab test, we recommend that you begin with the software (SeaCast) manual.

If you are focussed on instrument maintenance, we recommend that you begin with the instrument manual.

If you are wishing to swap an Xchange™ sensor, we recommend that you read the appropriate Xchange™ manual.

Shipping & Receiving

Receiving an Instrument

When an instrument is received at a new location it is prudent to perform the following steps to ensure the instrument is capable of performing when required.

- Check the shipping container for signs of damage. This could indicate damage to the instrument inside.
- The shipping package should include all of the following items
    - Smart•X instrument
    - Data/Power cable
    - Black dummy plug
    - One primary sensor blanking plug
    - Two secondary sensor blanking plugs
    - CD with manuals and documentation
- Check for damage
    - Check the cable for slices or gouges
    - Check the connector sockets for corrosion, dirt and salt deposits
    - Check the pressure case for dents and scrapes
    - Check the sensors for cracks or bends
- Check all the Xchange™ sensors are installed tightly. The blue retaining ring should be within 1 mm of the instrument end cap.
- Connect the instrument to a computer with the data cable and perform a scan, or monitor if using SeaCast.

Returning an Instrument to the Factory

- If shipping for repair or recalibration obtain an RMA number from the service centre.
- Pack the instrument in its original shipping box, if possible, to prevent damage during shipping

An RMA number can be requested using any of the following contact options:

Service:
To request an RMA or technical support

Email: service@AMLoceanographic.com
Phone: 1-250-656-0771
Phone : 1-800-663-8721 (NA)
Fax: 1-250-655-3655

Website:
http://www.AMLoceanographic.com

My AML Oceanographic:

RMA requests may also be submitted through *My AML Oceanographic* (once logged in) or by navigating to the 'Support' tab on the AML Oceanographic website.

Mailing and Shipping Address:

AML Oceanographic.
2071 Malaview Ave.
Sidney, BC, Canada
V8L 5X6

Using the Instrument

Pressure Ratings

Pressure ratings are given for both the P•Xchange™ sensors and the entire instrument. Deployments should never exceed the lower of these two pressure ratings. For example, a 500m instrument equipped with a 6000 dBar (0-6000m) P•Xchange™ sensor is limited to deployments of 500m depth or less. Similarly, a 6000m instrument equipped with a 500 dBar (0-500m) P•Xchange™ sensor is also limited to deployments of 500m depth or less.

It is desirable to optimize the accuracy of pressure measurements by using a P•Xchange™ sensor with a pressure range that closely matches the depth of the deployment.

Caution: Do not exceed the specified pressure ratings of the P•Xchange™ sensor or the instrument housing. Overpressure can result in damage to the P•Xchange™ sensor and the instrument.

Pre-Deployment Procedures

- 4 to 6 weeks ahead
  - Use the receiving steps above to verify the instrument is in good working order.
  - Verify the calibrations of all sensors are valid for the duration of the deployment. If not, swap the Xchange™ sensors for sensors with valid calibrations or send the Xchange™ sensors to a service center for recalibration.
  - Lightly lubricate the connectors with 3M silicone spray or equivalent.
- Before leaving the jetty
  - Verify the P•Xchange™ pressure range is appropriate for the depth of the deployment.
  - Connect the instrument to a computer using the data cable.

Caution: Install blanking plugs in all unused sensor ports prior to deployment. Failure to install blanking plugs will result in damage to the connectors.

C•Xchange™ & SV•Xchange™ blanking plug

T•Xchange™ & P•Xchange™ blanking plug

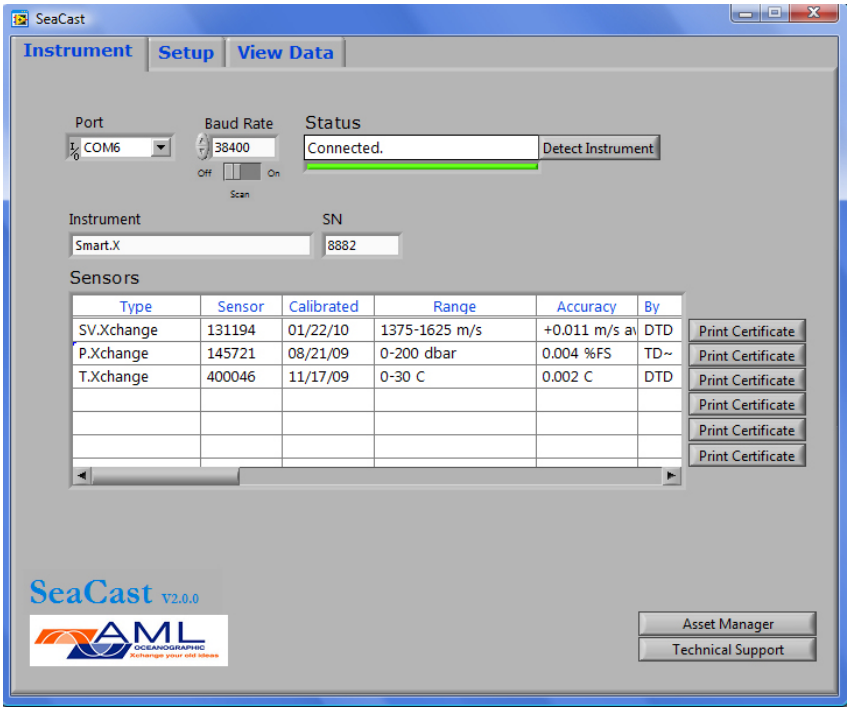
Configuring Sampling Parameters using SeaCast

AML Oceanographic' SeaCast application software greatly simplifies the process of setting up an instrument to complete a profile.

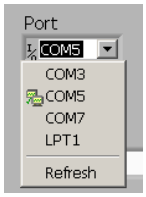
Full details on the instrument configuration process can be found in the SeaCast manual. Below please find a quick summary of that process:

Selecting an Instrument for Configuration

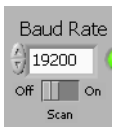
On the Instrument Tab, the first row of fields 'Port', 'Baud Rate' and 'Status' control and display the communications with the instrument.



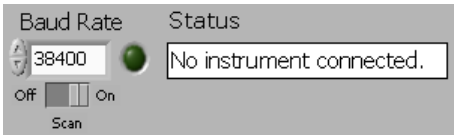
The 'Port' field allows the user to select the computer communications port to which the instrument is connected. If uncertain about the port the user can check the ports in the Device Manager or Hardware Manager found in the control panel in the Windows operating system. The 'Refresh' selection at the bottom of the list allows the user to force a new detection of available ports. This is useful if a USB connection is made after SeaCast is launched.



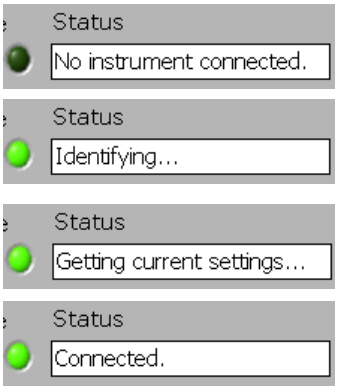
The 'Baud Rate' field is used to select the baud rate the user wishes to use while communicating to the instrument. Lower baud rates allow longer cables to be used if using RS-232/485/422. Higher baud rates shorten the data transfer times. Choose 38,400 baud whenever possible.



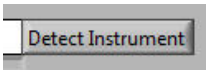
If an instrument is set to autobaud (default setting) it will detect the baud rate chosen in SeaCast and communicate at that baud rate. If the baud rate is changed in SeaCast then power to the instrument must be cycled to re-establish communications at the new baud rate.



Some instruments are set up to communicate at fixed baud rates. In this case the baud rate in SeaCast must be set to the same baud rate as the instrument. If the instrument baud rate is unknown, the 'Scan' switch below the 'Baud Rate' field can be used to have SeaCast cycle through all the baud rates to try to detect the instrument baud rate.



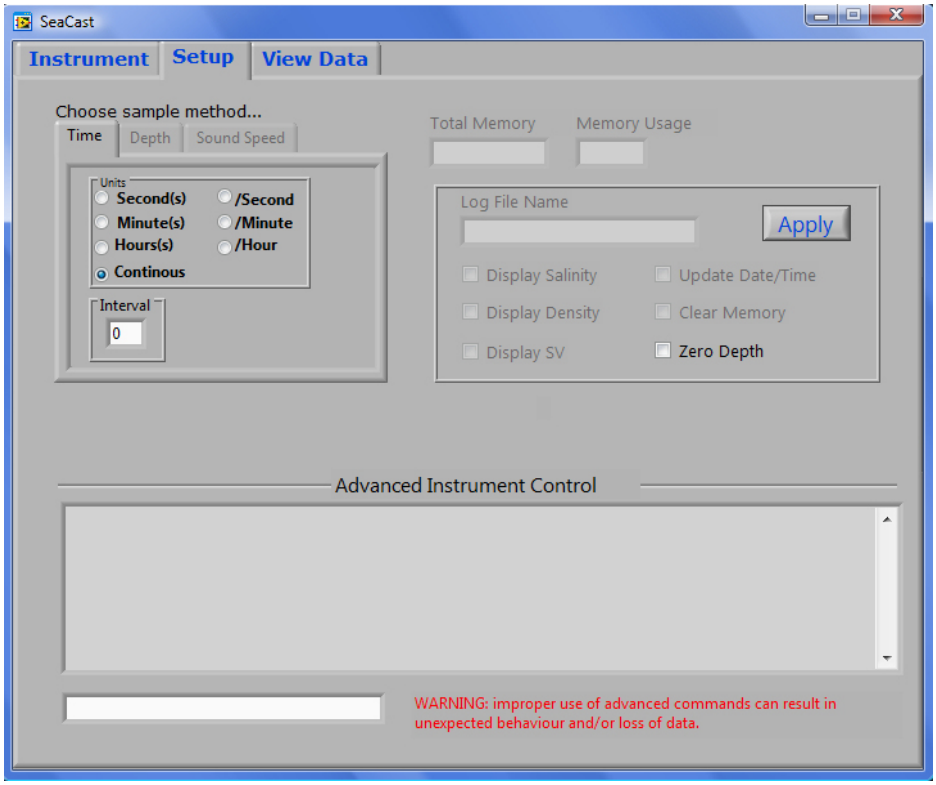
The "Status" field shows the status of the communications with the instrument. The green light indicates that communications have been established with the instrument. During the identification process, SeaCast is determining the type and serial number of the instrument and any connected sensors. During the settings process, SeaCast is determining the latest sampling and logging settings that were programmed into the instrument. When all the required handshaking has been completed, the 'Status' field will show "Connected" and the user may now use the instrument. Please note that the handshaking can take up to 30 seconds to complete.



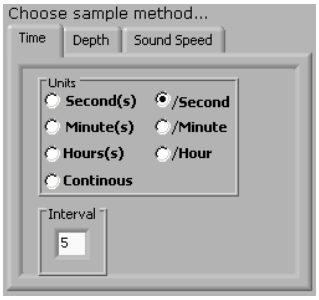
The Detect Instrument button forces SeaCast to re-detect and re-identify the instrument and its sensors.

Configuring the Selected Instrument

After the instrument has been detected by SeaCast, select the Setup tab at the top of the SeaCast window.



The box in the upper left of the Setup page controls the sampling of the instrument. For the Smart•X only the time increment sampling method is available. I.e. sample at 25 times per second, 10 times per hour, every 5 seconds, etc. The continuous selection sets the instrument to sample as fast as possible. For the Smart•X this is 25 Hz.



Sampling Method Selection Tab

Instrument Time, Memory & Log File Settings

The Smart•X does not contain batteries, internal memory or a real-time clock. Therefore data logging is not available.

The Smart•X does maintain an internal timer to provide for various sampling rates. This timer measures time from power up. If required the timer output can be added to the scan data using the SET SCAN TIME command. It can be disabled with the SET SCAN NOTIME command. The time output format is hh:mm:ss.ss. I.e. hours:minutes:seconds

Example output:

```
Smart.X Version 4.09 SN:8882
AML Oceanographic Ltd.

>scan
 1473.714  0000.151  17.355
>set scan time
>scan
00:03:05.89  1473.634  0000.151  17.353
>set scan notime
>scan
 1473.584  0000.144  17.343
>
```

Configuring Sampling Parameters with HyperTerminal

Instruments can also be configured for deployment using HyperTerminal or other terminal emulation programs. As with SeaCast, communications with the instrument must be established using the correct communications port and settings. The communications settings are 8 data bits, 1 stop bit, no parity, no flow control and the desired baud rate.

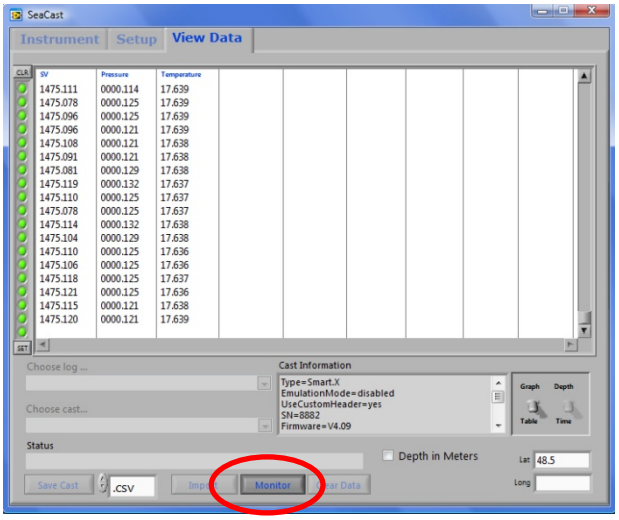
The sampling parameters can be programmed by entering text commands. The following are examples:

SET SAMPLE RATE CONTINUOUS	Sets the sample rate to as fast as possible (25 Hz)
SET SAMPLE RATE 5/s	Sets the sample rate to 5 samples per second
SET P INC 1	Sets the sample rate to pressure increments of 1 dbar
SET SOUND INC 2	Sets the sample rate to sound speed increments of 2 m/s

Please consult the Commands section of the Appendix for full syntax details on how to issue the commands in question. Please note that the above are example commands only; many additional sampling regimes can be established.

Monitoring Real Time Data

- Ensure the pre-deployment procedures have been done (see Page 6).
- Ensure that the desired sampling requirements have been selected and applied.
- Plug the data/power cable into the instrument. If you power the instrument over a long cable, please note the following:
  - The longer the cable the higher the voltage drop on the cable. The voltage drop on a standard AML cable, with a standard Smart•X, is about 2 volts per 100m of cable while sampling and 0 volts per 100m when in low power mode.
  - The instrument's auto shutdown voltage has a default level of 8 volts.
  - The instrument's maximum voltage is 26 volts.
  - The voltage at the instrument, while sampling, must be above the shutdown level for the instrument to operate.
- With the instrument in air, use the zero command to zero the barometric pressure offset.
- Securely attach the cable to the instrument.
- Lower the instrument until it is just submerged. Keep the instrument at this depth for 2 minutes prior to beginning the cast. This allows the sensors time to wet and the pressure case to shed heat.
- Begin monitoring data using SeaCast or HyperTerminal.
- Send the instrument down to the desired depth and return it to the surface.
- Note that with the Smart•X in the typical, vertical orientation, the downcast is usually more accurate than the upcast data since the downcast measurements are not contaminated by the thermal shedding from the pressure case.



Post-Deployment Procedures

- When the instrument is pulled from the water it should be rinsed in fresh water.
- Dry the area around the connectors with a clean cloth or compressed air prior to disconnecting the plugs or cables. Do not blow compressed air into the Pressure•Xchange™ sensor.
- Remove the shorting plug or cable. Place dummy plug in the connector to protect it.
- Dry the instrument and stow it securely.

Configuring the Instrument for Data on Power Up

Perform the following steps:

- Open a terminal emulation program, such as HyperTerminal, and ensure the serial port has been selected in the program. If the instrument has been set to a specific baud rate with the SET DETECT command the terminal emulation program must be configured for that baud rate.
- Connect the instrument to the computer using the data/power cable supplied with the instrument.
- Using the terminal emulation program issue the following commands to the instrument:
    - SET STARTUP NOHEADER (disables the power up header information)
    - SET STARTUP MONITOR (enable data output on power up)
    - SET SAMPLE RATE 10/S (set the desired sampling rate)
    - SET DETECT 07 (set fixed 38400 baudrate)

    Note details on the SET DETECT command can be found in the appendix.
- Unplug the data/power cable from the instrument to turn the instrument off.
- Plug the data/power cable into the instrument to turn the instrument on.

Disabling Data on Power Up

Perform the following steps:

- Open a terminal emulation program, such as HyperTerminal, and ensure the serial port has been selected in the program. If the instrument has been set to a specific baud rate with the SET DETECT command the terminal emulation program must be configured for that baud rate.
- Connect the instrument to the computer using the data/power cable supplied with the instrument. Instrument data will stream through the terminal emulation program window.
- Unplug the data/power cable from the instrument to turn the instrument off.
- Hold down < ENTER >
- Plug the data/power cable into the instrument to turn the instrument on.
- Release the <ENTER> key once the prompt '>' is displayed.
- Using the terminal emulation program issue the following commands to disable data on powerup:
    - SET STARTUP HEADER (enables the power up header information)
    - SET STARTUP PROMPT (disable data output on power up)
    - SET SAMPLE RATE 10/S (selects the desired sampling rate)
    - SET DETECT A7 (set 10 autobaud attempts then default to 38400 baud)

    Note details on the SET DETECT command can be found in the appendix.
- Unplug the data/power cable from the instrument to turn the instrument off.

Maintaining the Instrument

Periodic Maintenance

Periodic maintenance will prolong the life of the instrument. The following is recommended:

- If the instrument is very dirty or oily use warm soapy water and allow the instrument to soak before cleaning with a rag or soft brush. Rinse with fresh water.
- Before each use
    - Check the tightness of swappable sensors
    - Check for nicks and cuts on the cable
- After each use
    - Clean and rinse the instrument using fresh water
    - Dry and safely store the instrument
- Monthly
    - Lightly lubricate the connector contacts with 3M silicone spray or equivalent
- Yearly
    - Send the instrument or Xchange™ sensors to a service centre for diagnostics and re-calibration

Communications

PC Settings

The Smart•X will communicate with both RS-232 and RS-485 serial connections. The computer to which the instrument is connected must be set up as follows:

- 8 bits
- 1 stop bit
- No parity
- No hardware handshaking
- Baud rate of 600, 1200, 2400, 4800, 9600, 19,200 or 38,400 baud

After power up, the Smart•X will wait for an ASCII carriage return. The instrument will automatically detect whether communications are RS-232 or RS-485 as well as the baud rate.

Output Formats

Output formats can be modified by the user. If the modifications required are not supported by the commonly used command list in the next section, please contact the factory and we will support your requirements.

The user can change:

- The number of decimal places for each channel
    - Turn on or off: elapsed time and calculated parameters, power up information (header), automatic monitoring on power up

Default output format

The output from the Smart•X is space separated values. There are commands to change the delimiter to tab or comma separated values if required.

The following table shows the output units for each Xchange™ sensor.

Sensor	Units	Default Format	Notes
SV•Xchange™	m/s	1234.567	
Conductivity•Xchange™	mS/cm	12.346	
Pressure•Xchange™	dBar	1234.56	
Temperature•Xchange™	C	12.345	

SV,P,T sensors

Default

Sound velocity	Pressure	Temperature
m/s	dbar	C

The data channel outputs with all calculated parameters turned on are

Time	Sound velocity	Pressure	Temperature	Density	Salinity
hh:mm:ss.ss	m/s	dbar	C	kg/m^3	ppt

C,P,T sensors

Default

Conductivity	Pressure	Temperature
mS/cm	dbar	C

The data channel outputs with all calculated parameters turned on are

Time	Conductivity	Pressure	Temperature	Density	Salinity	Sound velocity
hh:mm:ss.ss	mS/cm	dbar	C	kg/m^3	psu	m/s

Example outputs:

Example outputs are shown below. User inputs in the output capture shown below are in bold type.

```
Smart.X Version 4.09 SN:8882
AML Oceanographic Ltd.


>scan
 1473.924  0000.182  17.260
>set scan time
>set scan salinity
>set scan density
>scan
00:00:56.25  1473.912  0000.163  17.258  00.226  0998.907
>set scan notime
>set scan nosal
>set scan noden
>scan
 1473.916  0000.182  17.256
>monitor
 1473.912  0000.182  17.254
 1473.920  0000.182  17.255
 1473.915  0000.185  17.254
 1473.926  0000.178  17.254
 1473.921  0000.178  17.255
 1473.919  0000.182  17.256
 1473.920  0000.185  17.257
 1473.916  0000.182  17.258
 1473.915  0000.178  17.257
 1473.913  0000.178  17.256
 1473.909  0000.182  17.256
 1473.916  0000.185  17.256
>detect
Detecting Sensors
1: SV-C.Xchange SV.X SN 131194 01/22/10 SN: 65535
```

```
2: P-T.Xchange P.X SN 145721 08/21/09 T.X SN 400046 11/17/09 SN: 65535
Detection complete
>
```

```
>display options
[Instrument]
Type=Smart.X
EmulationMode=disabled
UseCustomHeader=yes
SN=8882
Firmware=V4.09
SampleUnits=continuous
SampleInterval=0
PressureInc=0.00
SoundInc=0.00
TestLog=test.raw
Date=01/01/00
Time=00:00:00
MemorySize=0.0 MB
MemoryUsed=0.0 MB
DisplayTime=no
DisplayDate=no
DisplaySalinity=no
DisplayDensity=no
DisplaySoundVelocity=no
DisplayBattery=no
RelayMode=auto detection
RealtimeLogging=no
LoggingTimeout=0
StartupDelay=20
DisplayHeader=yes
StartupMode=prompt
CharacterReception=yes
LoggingBreakMode=no
DetectionMode=A3
BatteryACoefficient=+3.500000E-01
BatteryBCoefficient=+2.500000E-02
ShutDownVoltage=6.5
WarningVoltage=not applicable
PressureOffset=0.00
UsePressureOffset=no
SoundVelocityThreshold=1375.00
DelimterMode=Space
SensorDetectionMode=Once
Traceability=no
SkipPowerOff=no

[Slot 1]
SensorName=SV-C.Xchange SV.X SN 131194 01/22/10
BoardSN=65535

[Slot 2]
SensorName=P-T.Xchange P.X SN 145721 08/21/09 T.X SN 400046 11/17/09
BoardSN=65535
>
```

Customer Support

Troubleshooting

Instrument fails to communicate:

- Check the cables
    - Is the data power cable connected to the instrument and computer?
    - If using a cable other than an AML cable, it should be configured as a null modem cable.
    - If using multiple cable lengths, the extensions should not be configured as null modem cables.
    - Are there any cuts in the cable?
- If powering over a long cable, check the voltage drop over the cable. Measure the voltage across a 10 watt, 27Ω, resistor across pins 2 and 3 of the cable. The voltage must be above 8 volts.
- Are the communication settings in the program used on the computer correct?
    - Comm port selection
    - 8 bits
    - 1 stop bit
    - No parity
    - No hardware handshaking
    - Baud rate between 600 and 38,400 baud
- Are the communication settings in the instrument correct?
    - Was the instrument specifically set to one baud rate last time? If so, the user must use that baud rate to resume communications.
    - Was the instrument set to only RS-232 or only RS-485 last time? If so, the user must resume communications in the required protocol.
    - Was the instrument set to RX OFF last time? If so, a carriage return must be sent to the instrument immediately after power is applied to interrupt this mode.
    - Was the instrument set to monitor on power up mode? If so, a carriage return must be sent to the instrument immediately after power is applied to interrupt this mode
- Is the connector damaged?

Instrument generates noisy data:

- Is the connector damaged, dirty or corroded?
- Is there noise on the power supply? Switching power supplies are common sources of noise.
- Nearby EMI sources such as electric motors can create noise. If possible move the instrument and its cables away from the noise source.
- Are there bubbles on the SV•Xchange™ sensor or in the Conductivity•Xchange™ sensor?
- Is the SV•Xchange™ sensor clean?
- Is the Conductivity•Xchange™ sensor clean?
- Is the temperature sensor damaged?
- Is there something nearby affecting the water temperature?

AML Oceanographic Contact Info

Service:
To request an RMA or technical support
Email: service@AMLoceanographic.com
Phone: 1-250-656-0771
Phone : 1-800-663-8721 (NA)
Fax: 1-250-655-3655

Sales:
For all general sales inquiries
Email: sales@AMLoceanographic.com
Phone: 1-250-656-0771
Phone : 1-800-663-8721 (NA)
Fax: 1-250-655-3655

Website:
http://www.AMLoceanographic.com

My AML Oceanographic:

My AML Oceanographic is AML's on-line data centre. This secure area within our website is designed to offer one easy location for interested individuals and organizations - distributors, customers, prospects, and other members of our community - to manage their interactions with AML. The functionality within My AML Oceanographic is expected to evolve quickly. Upon launch, My AML Oceanographic will allow you to:

- View and manage your assets (instruments and sensors)
- Consult instrument diagnostic summaries
- View and download calibration and conformity certificates
- View and manage your technical support cases
- Consult and download sales estimates, sales orders, and invoice copies
- View account balances and generate account statements
- Assess inventory availability at AML

Appendices

Commands

When using SeaCast, the command set is not usually necessary. However, text commands are available. Below is a listing of commonly used commands. Note that some commands are only be available on instruments equipped with the appropriate with Xchange™ sensors.

Communications commands

Command	Description	Requires
SET FORCE 232	Sets com mode to RS-232. Power must be cycled for changes to take effect.	
SET FORCE 485	Sets com mode to RS-485. Power must be cycled for changes to take effect.	
SET FORCE AUTO	Sets for auto-detection of RS-232 or RS-485 comms. Note that if instrument is not connected to a com port on power up, it assumes RS-485 operation & will remain in that mode until powered down.	
DISPLAY FORCE	Displays current com mode (ie RS232, RS485, AUTO)	
DISPLAY DETECT	Displays the baud rate detection settings.	
SET DETECT ab	Sets the baud rate detection. 'a' sets the number of autobaud detection attempts before the instrument reverts to the default baud rate set by 'b'. Setting 'a'=0 forces the instrument to a fixed baud rate determined by 'b'. 'b'= 1 = 600 baud 4 = 4800 baud 7 = 38400 baud 2 = 1200 baud 5 = 9600 baud 8 = 57600 baud 3 = 2400 baud 6 = 19200 baud 9 = 115200 baud	

Sampling rate commands

Command	Description	Requires
DISPLAY SAMPLE RATE	Displays the time based sampling rate	
SET SAMPLE n t	Sets the desired sampling rate. 'n' is a number and t is the time units. Examples are SET S C sets the sampling to continuous (25 Hz) SET S 5 /s 5 samples per sec SET S 1 s 1 sample per second SET S 2 /m 2 samples per minute SET S 5 m 1 sample every 5 minutes SET S 2 /h 2 samples per hour SET S 24 h 1 sample every 24 hours	

Output format commands

Command	Description	Requires
DISPLAY SCAN	Displays current scan options.	
SET SCAN NODENSITY	Turns the calculated density channel off.	C•X, T•X, and P•X Or SV•X, T•X, and P•X
SET SCAN DENSITY	Turns the calculated density channel on.	C•X, T•X, and P•X Or SV•X, T•X, and P•X
SET SCAN NOSALINITY	Turns the calculated salinity channel off.	C•X, T•X, and P•X Or SV•X, T•X, and P•X
SET SCAN SALINITY	Turns the calculated salinity channel on.	C•X, T•X, and P•X Or SV•X, T•X, and P•X
SET SCAN NOSV	Turns the calculated salinity channel off, removing it from the instrument output scans. Current salinity display status is viewable using DIS SCAN.	C•X, T•X, and P•X
SET SCAN SV	Turns the calculated sound velocity channel on, allowing it to be present in instrument output scans. Current salinity display status is viewable using DIS SCAN. This is only available when C,P and T sensors are attached.	C•X, T•X, and P•X
SET SCAN TIME	Enables displaying time in data scan	
SET SCAN NOTIME	Disables time from being displayed in data scan	
DIS DELIMITER	Displays the current delimiter setting for the scan/monitor/log output. Options available are space, comma, and tab.	
SET DELIMITER SPACE	Sets the delimiter to space separated values for scan/monitor/log output	
SET DELIMITER COMMA	Sets the delimiter to comma separated values for scan/monitor/log output	
SET DELIMITER TAB	Sets the delimiter to tab separated values for scan/monitor/log output	
DISPLAY STARTUP	Displays the power up output settings	
SET STARTUP PROMPT	Sets the instrument to wait for user commands on power up.	
SET STARTUP SCAN	Sets the instrument to output one scan on powerup nd then wait for a user command.	
SET STARTUP MONITOR	Sets the instrument to start monitoring data on power up	
SET STARTUP NOHEADER	Disables the instrument identification header output on powerup.	
SET STARTUP HEADER	Enables the instrument identification header output on powerup.	

General commands

Command	Description	Requires
SCAN	Measure and output one scan of data	
MONITOR	Scan at the set sampling rate.	
VERSION	Displays the instrument identification header.	
DISPLAY OPTIONS	Displays the instrument status and user settings	
ZERO	Corrects the barometric offset to set zero pressure at surface for current barometric pressure	P•X
ZERO OFF	Disables barometric offset	P•X
DIS TIME	Displays current time. Time format is HH:MM:SS.ss	
SET TIME hh:mm:ss.ss	Sets instrument time using 24 hour clock of format hh:mm:ss.ss	
DETECT	Checks each slot in logger board to identify what is plugged in and displays sensor / board type & serial number or empty for each slot.	
TALK n	Enables communications directly with a sensor board via the logger board, where n = value from 1-3 that identifies the slot number of the board to be communicated with. See Detect command.	
CTRL+C	Press ctrl key and c key at same time to exit sensor board talk mode & return to logger communications.	

Technical Specifications

Sensors

Primary Xchange™ Sensors					
Type	Range	Accuracy	Precision	Resolution	Response Time
Conductivity•Xchange™	0 to 70 mS/cm	±10 µS/cm	±3 µS/cm	1 µS/cm	25 ms at 1 m/s flow rate
Conductivity•Xchange™	0 to 2 mS/cm	±10 µS/cm	±0.6 µS/cm	0.1 µS/cm	25 ms at 1 m/s flow
SV•Xchange™	1375 to 1625 m/s	±0.025 m/s	±0.006 m/s	0.001 m/s	47 µs

Secondary Xchange™ Sensors					
Type	Range	Accuracy	Precision	Resolution	Response Time
Temperature•Xchange™	-2°C to 32°C	±0.005°C	±0.003°C	0.001°C	100 ms
Temperature•Xchange™	-2°C to 45°C	±0.008°C	±0.004°C	0.001°C	100 ms
Pressure•Xchange™	50, 100, 200, 500, 1000, 2000, 4000, 5000 & 6000 dbars	±0.05%FS	±0.003%FS	0.002%FS	10 ms

Calculated Parameters				
Type	Required Sensors	Equation	Accuracy	Range
Salinity	C.X, T.X, P.X	EOS80	±0.010 psu	0 to 42 psu
Salinity	SV.X, T.X, P.X	AML '07	±0.035 ppt	0 to 42 ppt
Density	C.X, T.X, P.X	EOS80	±0.027 kg/m^3	990 to 1230 kg/m^3
Density	SV.X, T.X, P.X	EOS80	±0.051 kg/m^3	990 to 1230 kg/m^3

Electrical

- Mother Board
    - 2 dedicated slots
        - Primary Xchange™ sensor slot
        - Secondary Xchange™ sensor slot
- Sensor Boards
    - Sound velocity or conductivity Xchange™ sensor board
    - Pressure and temperature Xchange™ sensor board

- Auto detect RS232 or RS485 (½ duplex ASCII)
- Autobaud to 38,400

Power

- Current
    - 220 mA when sampling
    - 25 mA in standby mode
    - 60 µA when in low power mode

External Power Supply		
Status	Type	Voltage range
Standard	External	8 to 26 VDC

Pressure Case

- Environmental Limits
    - Storage, -20°C to 60°C
    - Usage, -20°C to 45°C

Housing						
Status	Type	Depth Rating	Diameter	Length	Weight (in water)	Weight (in air)
Standard	Delrin	1000 m	76mm (2.98")	565mm (22.3")	0.23 Kg (0.5 lbs)	0.82 Kg (1.8 lbs)
Optional	Titanium	6000 m			1.35 Kg (3.0 lbs)	1.94 Kg (4.3 lbs)

Connectors					
Type	Status	Pins	Sex	Material	Manufacturer
Bulkhead	On Delrin housings	Micro 8	Female	SS316	Subconn
Bulkhead	On titanium housings	Micro 8	Female	Titanium	Subconn

Sampling Capabilities

- Frequency
    - Time: selectable sample rates from 25 per second to 1 per hour
- Configurations
    - Single scan or continuous output
    - on command or autonomous on power up

Included Items

- Smart•X instrument
- 2m Data/Power Pigtail
- Black dummy plug
- One primary sensor blanking plug
- Two secondary sensor blanking plugs
- CD with manuals and documentation
- Sensor Protection Cage

Software

- SeaCast

Ordering Codes

Instruments

PDC-SMX-P1S2-05	Smart•X, 500 dbar, Delrin pressure housing
PDC-SMX-P1S2-60	Smart•X, 6000 dbar, Titanium pressure housing
PDC-SMX-P1S0-05	Smart•X,500 dbar, Delrin pressure housing. Used as Smart SV replacement
PDC-SMX-P1S0-60	Smart•X,6000 dbar, Titanium pressure housing. Used as Smart SV replacement

Sensors

XCH-SV-STD	SV • Xchange™
XCH-PRS-0050	P • Xchange™ 50 dBar
XCH-PRS-0100	P • Xchange™ 100 dBar
XCH-PRS-0200	P • Xchange™ 200 dBar
XCH-PRS-0500	P • Xchange™ 500 dBar
XCH-PRS-1000	P • Xchange™ 1000 dBar
XCH-PRS-2000	P • Xchange™ 2000 dBar
XCH-PRS-4000	P • Xchange™ 4000 dBar
XCH-PRS-5000	P • Xchange™ 5000 dBar
XCH-PRS-6000	P • Xchange™ 6000 dBar
XCH-CND-RA070	C • Xchange™ Right Angle, Oceanographic (0-70mS/cm) Range
XCH-CND-RA002	C • Xchange™ Right Angle, Ultra Freshwater (0-2mS/cm) Range
XCH-CND-ST002	C • Xchange™ Straight, Oceanographic (0-70mS/cm) Range
XCH-CND-ST070	C • Xchange™ Straight, Ultra Freshwater (0-2mS/cm) Range
XCH-TMP-n232	T • Xchange™ -2 to 32 C Range
XCH-TMP-n545	T • Xchange™ -2 to 45 C Range

Accessories

SUB-G0031	Instrument suspension bar (requires smart mounting bracket assembly)
SUB-G0030	Smart mounting bracket assembly

Warranty

AML warrants the instrument for a period of two year from the date of delivery. AML will repair or replace, at its option and at no charge, components which prove to be defective. The warranty applies only to the original purchaser of the instruments. The warranty does not apply if the instrument has been damaged, by accident or misuse, and is void if repairs or modifications are made by other than authorized personnel.

This warranty is the only warranty given by AML. No warranties implied by law, including but not limited to the implied warranties of merchantability and fitness for a particular purpose shall apply. In no event will AML be liable for any direct, indirect, consequential or incidental damages resulting from any defects or failure of performance of any instrument supplied by AML.

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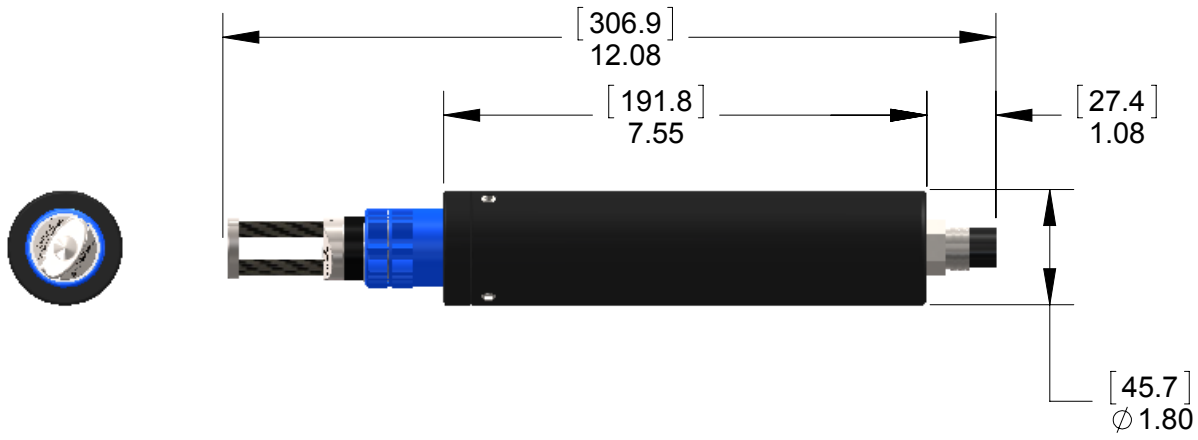
REVISION TABLE

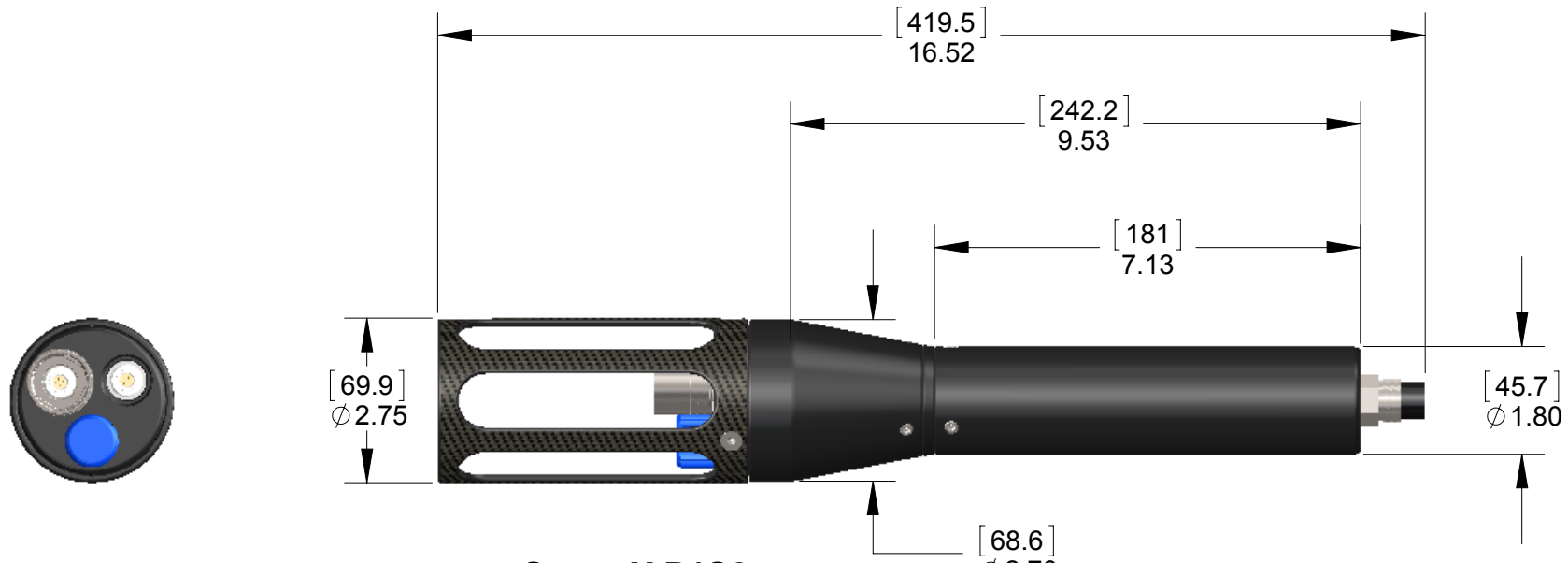
REV	DESCRIPTION	BY	DATE



Smart X P1S0 with SV Xchange

AML Part Numbers:
- Smart X P1S0: PDC-SMX-P1S0-05/60
- SV Xchange: XCH-SV-STD

Materials:
- Delrin - 500m Pressure Rating
- Titanium - 6000m Pressure Rating



Smart X P1S2

AML Part Numbers:
- Smart X P1S2: PDC-SMX-P1S2-05/60
- SV Xchange: XCH-SV-STD
- C Xchange: XCH-CND-RA[range]
- P Xchange: XCH-PRS-[range]
- T Xchange: XCH-TMP-[range]

Materials:
- Delrin - 500m Pressure Rating
- Titanium - 6000m Pressure Rating

Smart X - CTD Configuration

Smart X - SVTP Configuration

	Mass	
Model	**Delrin**	**Titanium**
Smart SV	.75lbs (.34 kg)	1.86 lbs (.84 kg)
Smart SV&T	.81 lbs (.37 kg)	2.02 lbs (.92 kg)
Smart X SV&T Configuration (Flared)	1.79 lbs (.81 kg)	4.19 lbs (1.90 kg)
Smart SV&P	.89 lbs (.40 kg)	2.24 lbs (1.02 kg)
Smart X SV&P Configuration (Flared)	1.77 lbs (.80 kg)	4.17 lbs (1.89 kg)
Smart SVT&P	.90 lbs (.41 kg)	2.24 lbs (1.02 kg)
Smart X SVT&P Configuration (Flared)	1.873 lbs (.85 kg)	4.28 lbs (1.94 kg)
Smart CTD (Flared)	1.74 lbs (.79 kg)	4.14 lbs (1.88 kg)

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Xchange your old ideas
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TITLE: Smart X Mechanical Overview

DRAWN: I.L.	DRAWING NO.: MC2-GA-03396	REV	AML NO.: N/A
DATE: NOV 26/10	MATERIAL: Delrin or Titanium		
3rd ANGLE PROJECTION; SIZE B	SLD FILE NO.: MC2-GA-03318		SHEET NO.: Sheet 1 of 2

TOLERANCES:
ANGLES: ± 1°
FRACTIONS: ± 1/32
HOLE SIZES: ± 0.005(0.13)
0.00: ± 0.015(0.38)
0.000: ± 0.005(0.13)

UNLESS OTHERWISE SPECIFIED:
ORIGINAL SCALE:1:5
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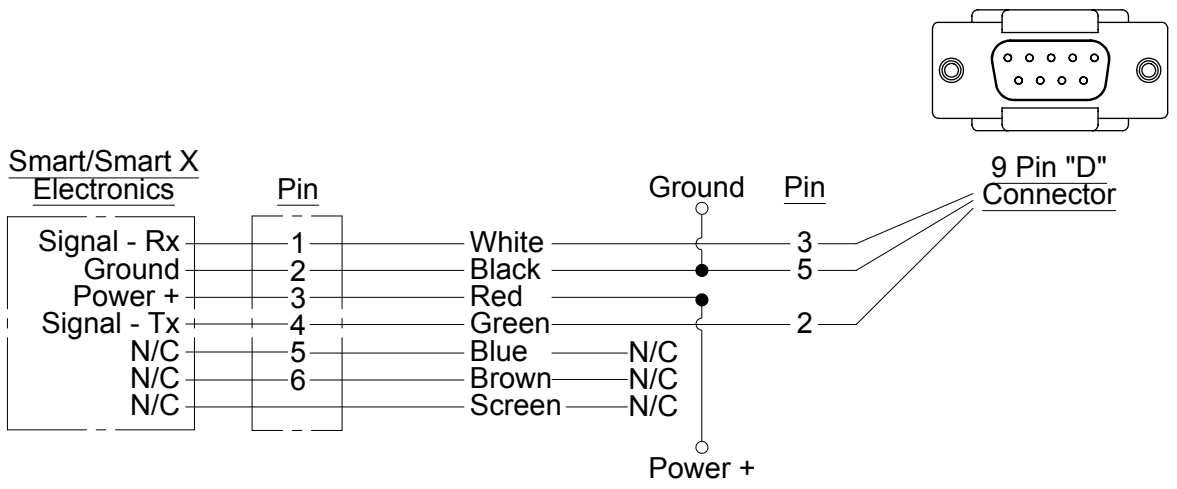
REVISION TABLE

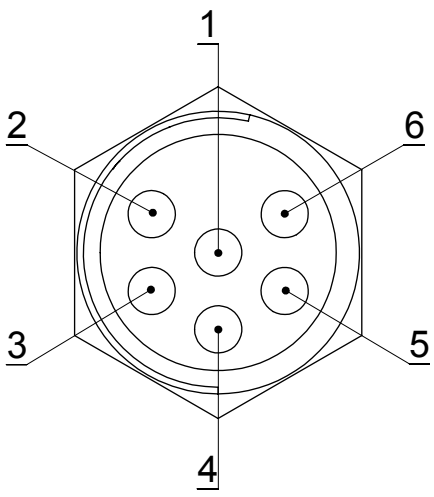
REV	DESCRIPTION	BY	DATE

SMART AND SMART-X ELECTRICAL INTERFACE SPECIFICATION

RS-232 COMMUNICATIONS



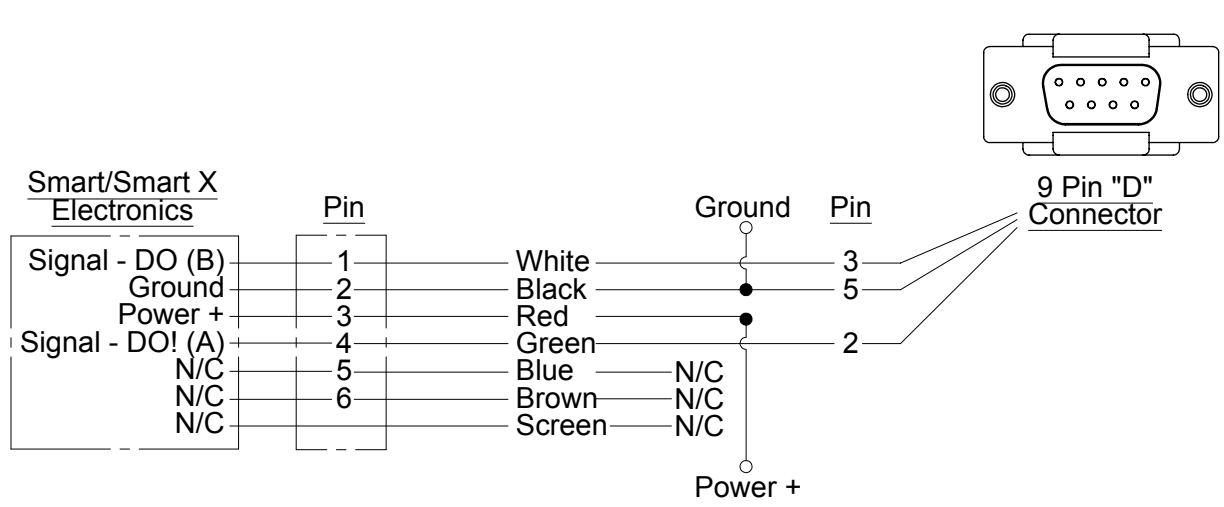
MCBH-6-FS
Bulkhead Face View



NOTE:

SMART INSTRUMENTS ARE CONFIGURED AT THE FACTORY FOR RS-232 OR RS-485. CONSULT THE SMART OR SMART X USER MANUAL FOR INSTRUCTIONS ON MAKING CHANGES TO YOUR INSTRUMENT'S COMMUNICATION PROTOCOL.

RS-485 COMMUNICATIONS



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TOLERANCES:
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0.00: ± 0.015(0.38)
0.000: ± 0.005(0.13)

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SURFACE FINISH: 63

TITLE: Smart Communications Overview

DRAWN	DRAWING NO.:	REV	AML NO.
I.L.	MC2-GA-03396		N/A

DATE	MATERIAL:
NOV 26/10	

3rd ANGLE PROJECTION | SIZE B | SLD FILE NO.: 9-pin D-sub Female | SHEET NO.: Sheet 2 of 2